## DESCRIPTION:

The complete system comprises of two units, a mobile unit (hereinafter called MU) and a base unit (hereinafter called BU). The MU connects to a laptop modem, PC modem or a voiceband modem connected to a computer. The BU connects to the telephone wall socket provided by a telephone company. However, the BU can also be connected to another laptop modem, PC modem, a modem connected to a computer.

Each of the two units, the MU and the BU comprise of the following main blocks:

1. A synchronization and authentication block
2. Wireless transceiver block
3. Two-four wire block
4. Off-hook detection block
5. Power adaptor block
6. Universal Serial Bus (USB) based power supply block

## BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS

Figure 1 shows how the MU is connected to the RJ-11 socket of the laptop modem. The adaptor just plugs into the RJ-11 socket. Optionally, the adaptor can be connected to a RJ-11 cable that can be plugged into the RJ-11 socket. Figure 1 also shows how the BU is connected to the RJ-11 wall socket. The adaptor just plugs into the RJ-11 socket in the wall. Optionally, the adaptor can be connected to a RJ-11 cable that can be plugged into the RJ-11 socket.

Figure 2 shows the block diagram of the MU. Figure 3 shows the block diagram of the BU. Figure 4 and Figure 5 show the state diagram of the MU and BU respectively. Figure 6 shows the tone detection block.

## DETAILED DESCRIPTION

The present invention describes a novel wireless adaptor that replaces a telephone wire by a wireless adaptor. The wireless adaptor is completely equivalent in functionality to

the wire; hence the user can use it to replace the wire connecting a laptop modem, a computer modem to the telephone wall socket. Such devices are hereinafter called as subscriber side equipment.

Reference is now made to Figure 1 that shows how the MU is connected to the laptop and BU connected to the wall socket.

**MU Functional Blocks**

Reference is now made to Figure 2 that details the block diagram of the MU system. The MU system design contains a control channel and a data channel, as indicated by the dashed and solid lines in Figure 2. The control channel is used for communicating certain control information to the BU, while the data channel is used for the data communication.

The Figure 2 shows a MU system that connects to a laptop modem through a RJ-11 jack. The RJ-11 jack output in the MU system is connected to a Data Access Arrangement (DAA) and a Hook Detect Block.

The DAA converts the modem's two-wire interface to a four-wire interface. In a two-wire interface, both transmit and receive signals travel on one pair of wires. The DAA, uses an echo cancellation mechanism to split the combined signal into transmit and receive signals, each of which travel on separate two-wire lines, thus converting the interface to a four-wire interface.

The two-wire interface is also connected in parallel to the Hook Detect Block, that senses when the laptop modem's on-hook/off-hook status and accordingly informs a micro-controller.

The transmit output of the DAA is sent to a signal conditioning block that changes the voltage levels of the signal to suit the wireless transmitter level. The output of the signal-

conditioning block is sent to a wireless transmitter. The output of the wireless transmitter is sent to an antenna.

The controller creates all the control signals and these are added to the data signal coming from the DAA arrangement to the input of the wireless transmitter. The wireless transmitter then sends both the control and the data signals to the BU.

The receive output of the antenna is sent to a wireless receiver which in turn sends the signal to a signal-conditioning block and to the controller. The controller carries out tone detection using a novel cost-effective technique, described below in the section on Tone Detection. Depending upon the tone detected, the controller takes a certain control action. The output of the signal-conditioning block is sent to the controller and the DAA that adjusts the voltage level and impedance of the interface to match that of the DAA.

**BU Functional Blocks**

Reference is now made to Figure 3 that details the working of the BU unit. The BU unit connects to the telephone wall socket through a RJ-11 jack. The output of the RJ-11 jack is connected to a load circuit that can be switched in or out through a relay switch. When the load circuit is switched in, it provides impedance to the telephone line voltage, and allows a current to flow through it that is detected by the telephone exchange as an indication of the system going on-hook. When the switch is open the circuit is open and no current flows through it, thus indicating to the telephone exchange that the system is off-hook.

The output of the RJ-11 jack through the switch is connected to a DAA, similar to the DAA of the MU side. The transmit signal from the DAA is connected through a signal conditioning circuit to the wireless transmitter. The controller creates all the control signals required and these are added to the transmit signal from the DAA at the wireless transmitter input. The signal conditioning circuit adjusts the voltage as required by the wireless transmitter. The output of the wireless transmitter is connected to an antenna.

The signal received from the antenna is sent to a wireless receiver. The output of the wireless receiver is sent to a signal conditioning circuit and the controller in parallel. The signal conditioning circuit adjusts the voltage level and impedance of the signal to match that of the DAA. The signal sent in parallel to the controller is used by it to detect the tone sent by the MU. Based on the tones sent, various control actions are taken by the BU.

**Initialization and Data Connection**

The initialization and connection steps are now explained in detail.

Figure 4 and Figure 5 explains the state machines of the MU and BU in detail. At start-up, the MU is plugged into the laptop modem and switched on. The BU is plugged into the telephone wall socket and switched on.

On being powered on, the micro-controllers on the MU and BU systems power-up their respective wireless transmitters and receivers. The BU waits for communication from the MU of a change in the hook status of the MU, as to whether it is on-hook or off-hook. A novel in-band signaling scheme is used to determine whether the MU is on-hook or off-hook. This is explained in detail in the section on Tone Detection below.

When a user wants to connect to the Internet using the dial-up connection, the laptop modem goes off-hook. Once the laptop modem goes off-hook, the off-hook detect circuit senses this change and signals the micro-controller. Upon micro-controller getting this signal, it takes two actions, a) it sends a power-up signal to the transmitter and receiver of the MU and b) it sends a different frequency tone, f2, to the BU for a fixed duration, T, of time and then goes silent. Upon the power-up signal being received, the transmitter and receiver sections of the MU are programmed to transmit and receive signals.

The change in the frequency from f1 to f2 is detected by the BU to indicate that the MU has gone off-hook and in turn the BU takes the relay switch off-hook. Also, the BU then switches on its transmitter for further communication. This completes the initialization action.

Upon the initialization being completed, the MU modem starts dialing out and sending training sequences to train the modems. In the MU, the modem of the laptop is connected to a DAA (data access arrangement) that converts the modem's two-wire interface to a four-wire interface (transmit and receive signals). The transmit signal from the laptop through modem is sent through this DAA to a wireless transmitter. The BU wireless receiver receives the wirelessly transmitted signals from MU. These signals are then sent to the DAA interface of the BU and through that to the telephone socket and the telephone network. The reverse path communication of BU to MU is done in a similar manner between the BU transmitter and MU receiver. So once initialization is over, the MU and BU open up a full-duplex wireless channel between them for transparently communicating the signals between the telephone exchange and the laptop modem between the MU and the BU.

The other functional blocks on the MU and BU are described below.

**Hook Detect Block**

The hook detect block detects the laptop modem changing its status and signals the controller regarding the same. The hook detection is carried out by feeding a current into the laptop modem through a current source. When the laptop modem goes off-hook, the current loop is completed and is sensed by the Hook Detect Block that signals the controller.

**Tone Detection**

Tone detection is carried out through a novel cost-effective manner and is shown in Figure 6. Initially when the MU in on-hook, a tone f1 is sent from MU to BU through the wireless transceiver. The BU detects this tone using a novel frequency counter that is robust to noise. In this frequency counter the received signal is first passed through a saturation amplifier that clamps the received signal. This output is then passed through a Schmitt trigger. The Schmitt trigger levels are adjusted so that the Schmitt does not trigger to noise and only to output. This allows for a high level of tolerance to noise. The Schmitt output is then passed to a frequency counter that counts the number of pulses for a given duration to determine the frequency.

**MU and BU Locking for Easy Carrying**

The locking of the MU into the BU also allows for the MU and BU to be carried together, thus making it easier for the user to carry the product. Further, the BU cavity that houses the MU RJ-11 jack provides for a protection for the jack to prevent accidental breakage due to it being dropped down.

**Out-of-Range Indicator**

There is an out-of-range indicator provided on the MU to indicate whether the BU received signal strength is below a threshold and therefore the systems may not connect.

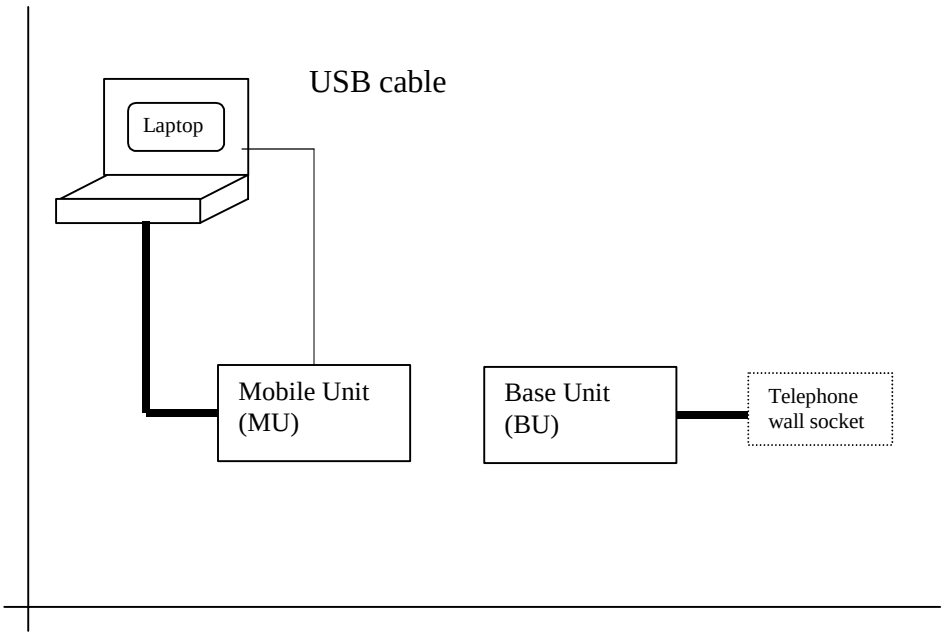


**Figure 1: MU connecting to Laptop and BU connecting to wall socket**

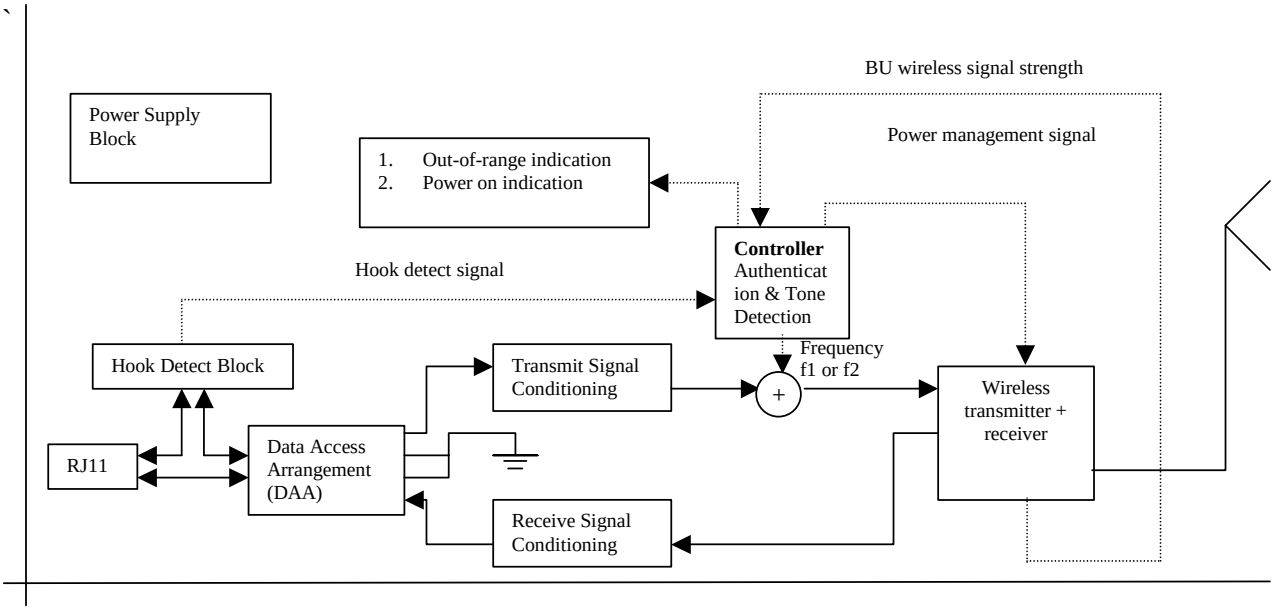


**Figure 2: MU system block diagram**

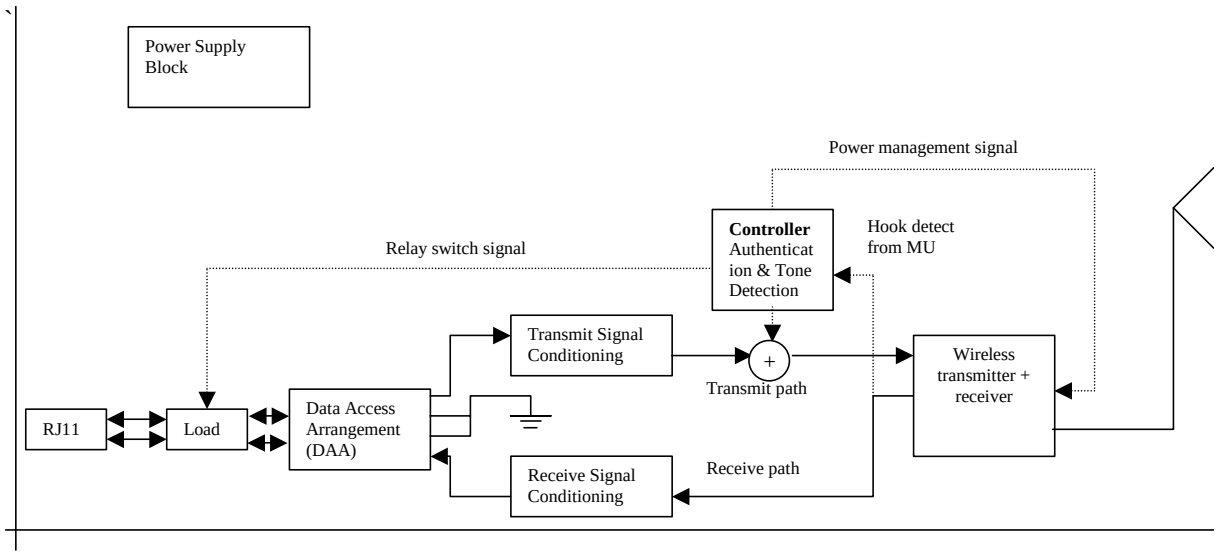


**Figure 3: BU system block diagram**

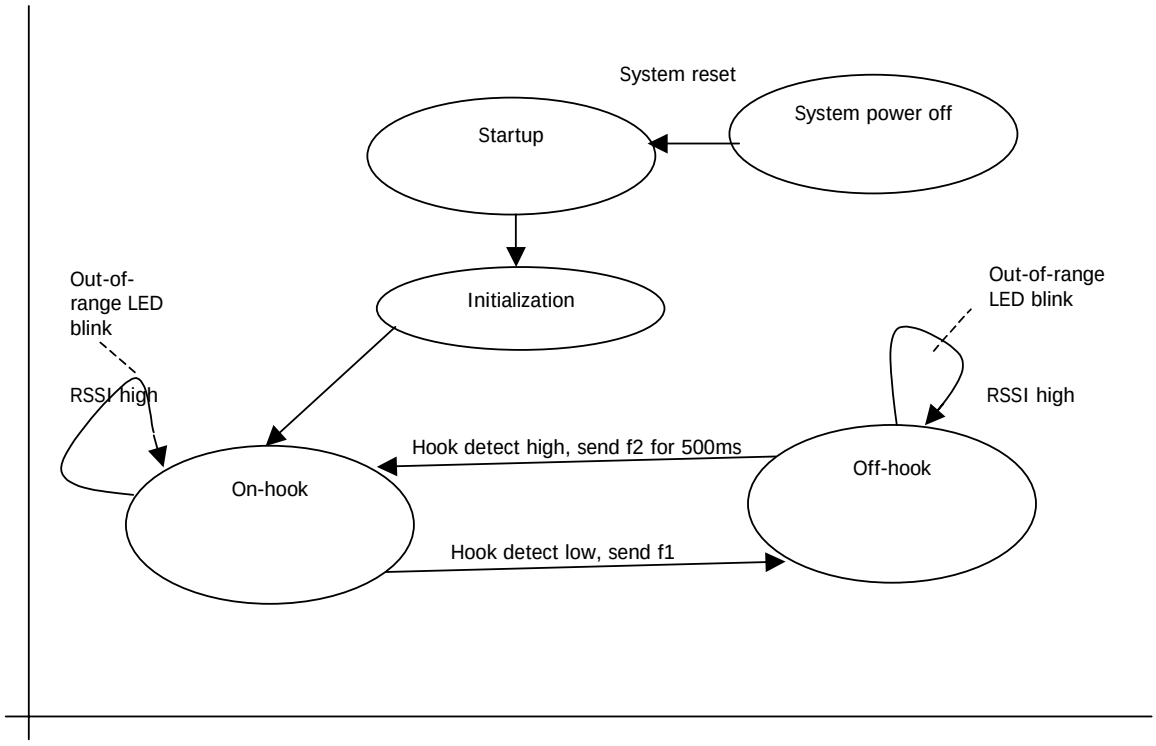


**Figure 4: MU state diagram**

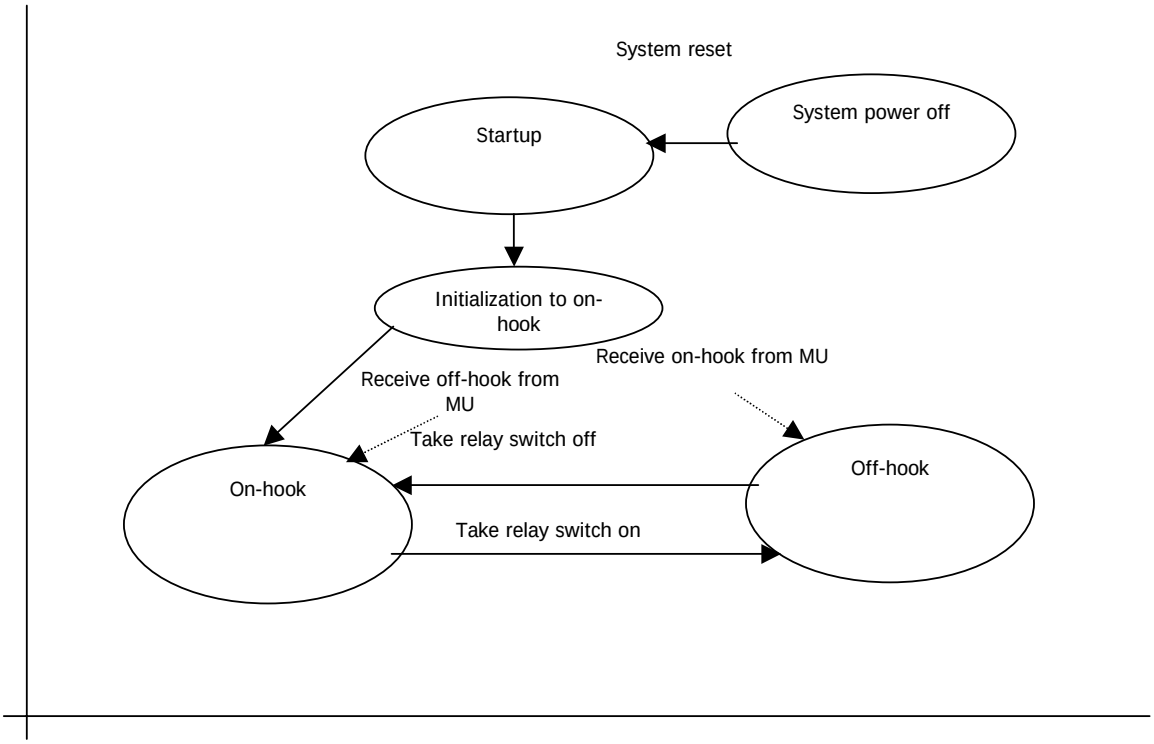


**Figure 5: BU state diagram**

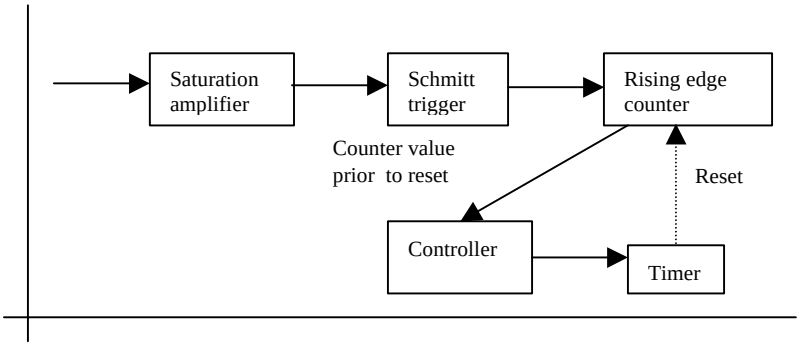


**Figure 6: Tone detection**